

Dear Katie,

I've spoken to David Yates, who is writing a history of the Computer Science Division. He remembers a demo of the network at the IEE about that time which will show very well how far it had developed. But he will have to check it from the records on which he is working. He should contact me tomorrow and I will send you a message.

He is working out with the officials how to get you the photos, which will not take long (1-2 weeks?).

Best regards,

Donald.

MESSAGE TO KATIE HAFNER FROM DONALD DAVIES

15 JANUARY 1996, ONE PAGE.

Dear Katie,

Thankyou for the fax received last night.

The first passage reads fine, but the last paragraph has been cut off at the words "overcome differences", so I cannot fully check.

The second is fine, but it places the discussion of line speed in the hotel bar. Actually it arises from the paper itself and is fundamental to our proposals. The paper was from the team at NPL, so I suggest something like:

"Another paper was presented by Roger Soantlebury. It came from Donald Davies' team at the National Physical Laboratory and discussed the work going on in England. It presented a detailed design study for a packet switched network. They proposed using channels that operated very much faster than the 2,000 bits-per-second mentioned in Roberts' paper and sharing their use dynamically. It was the first..."

Then remove the "He said.." sentence later.

Actually your version reads better because it gives substance to the bar discussion. If Larry Roberts doesn't veto this account of the bar discussion, which may have happened that way, you could leave it as you had it, except for the authorship of the paper (and the existence of a small team at NPL).

I've traced a good picture which was in either the Times or the Guardian newspapers. I have the date. I shall contact them but they may not keep the negatives.

Will you be setting packet switching in context with ATM, which has followed? This is part of the public network story, which is my interest but perhaps not relevant to your theme. It might become relevant to the future of Internet, but I suspect that unsuitable tariffs will inhibit its full use. I always regarded ISDN as a diversion from the proper development of public networks.

Yours sincerely,

*Donald*

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MESSAGE TO KATIE HAFNER FROM DONALD DAVIES

18 JANUARY 1996, ONE PAGE.

Dear Katie,

I expect you have heard from David Yates. I contacted the newspapers but they cull their picture libraries and after 5 years only very few are kept, certainly not this one. David has pictures from that time, anyway.

Since I sent my last comments it has worried me that you may think I will continue to niggle about details. Actually your last version would be fine. I see that the part after "overcome differences" was in an earlier version and has not changed, sorry.

Again, thankyou for taking trouble to get my viewpoint and ask again if you want to.

Yours sincerely,

*Donald*

FROM : DONALD WATTS DAVIES      PHONE NO. : 01552 755534      Jan. 14 1996 7:05PM P01

MESSAGE TO KATIE HAFNER FROM DONALD DAVIES

14 JANUARY 1996, ONE PAGE.

Dear Katie,

Called away to dinner last night, I forgot to answer your question.

We live about 20 miles WSW of the center of London, just 5 miles south of Heathrow airport. We would like to meet you and Matt when you are here, so let us know about a month before and we can fix a time.

One possibility is to come here en route to or from Heathrow, but that tends not to be a relaxed visit. We can be reached by train in 45 minutes from Waterloo Station, which has excellent connections by Underground/Subway. Or we could meet in Town quite easily.

I've just spoken to David Yates and he will acknowledge your e-mail at once. We discussed what pictures would be best and how to find them. It seems a bit difficult but we shall work on it.

Best regards to you both,

*Donald.*

MESSAGE TO KATIE HAFNER FROM DONALD DAVIES

13 JANUARY 1996, 2 PAGES.

Dear Katie,

Thanks for your quick reply. I'm glad to see your piece on the Gatlinburg Symposium.

It maybe reads as though Larry gave a paper and Roger Scantlebury discussed our work with him. Actually we gave a paper with a very detailed design study for a packet switched network. According to Roger it was at the end of his presentation that the discussion began, which was intensive and involved a group of people. Roger tells me that the discussion went on late into the night, around the bar in the hotel and Larry was there. You can ask Roger on +44 1372 464046.

I could fax you the paper if you don't have it. Headings are Introduction, Outline of the proposal, The users of the network, Control procedures involving the users, Design of the links and node computers of the high level network, Software organisation of the node computer, Performance of the node, The interface computer, The local network, Network economics, Conclusions and recommendations, 17 pages.

This is very much more than your present text suggests to the reader, so I hope you can convey the events of this important meeting more fully. To us it was confirmation that we were on to something big and that others shared our enthusiasm. Also we believed that we were well ahead in our design ideas. But we were limited in what we could actually build, mainly by money, so we opted for a local network and simulation for the routing and traffic aspects of a full system. The local network would teach us about the "interface computer".

You say that our lines were 20 time faster than Larry was proposing to use. Actually he mentioned "2000 bit/s at first" while we used 1.5 Mbit/s in our local network and proposed this for general use. This is 750 time faster! Considering the software limitations we could have done as well with, say, 250 Kbit/s but we had coaxial cables already in place and 1.5 Mbit/s was then a standard rate (it still is in the US.)

We were aiming at a transit time of 0.1 seconds maximum in the simulated WAN. In the LAN we built it was dominated by packet assembly time, but we could handle something between 250 and 500 packets per second and needed the high rate links for bursts of data.

Your second fax came through. Here are some suggested wordings:

"Independently, Davies also came up with a routing scheme which was adaptive, like Baran's but different in detail."

"Davies was concerned that circuit switched networks were poorly matched to the requirements of interacting computers. The irregular, bursty traffic did not fit well with uniform channel capacity. Circuit switching was the conventional technique, used in the telephone

network, but would make an inefficient communications system for computers. Dividing the capacity of a high rate line into packets could serve users according to their instantaneous demand. It was the matching of the network to the new types of traffic that was his main motivation."

You could go on, to widen the historical picture, but perhaps this comes either at the beginning or the end of your book:

"These ideas which were a motivation for packet switching in the 60s have a new flowering in the 90s. As the traffic in the public system became more varied, including data, voice, pictures and video, the same principles emerged again in 'Asynchronous Time-division Multiplexing' or ATM, which uses short, 53 byte packets called 'cells' and has protocols to handle every kind of traffic including telephony, where the delay is critical. This is packet switching adapted to current technology.

The possibility of handling voice was discussed in early NPL work and they transmitted voice in the NPL local network as an experiment, but the technology of the day was not ready for all kinds of traffic in one public network. Now it is possible with ATM, the successor of packet switching.

Thankyou very much for taking this trouble. Don't hesitate to ask again if you wish, but it is getting late here and I detect dinner cooking.

Yours sincerely,

*Donald*

MESSAGE TO KATIE HAFNER FROM DONALD DAVIES

13 JANUARY 1996, 2 PAGES.

Dear Katie,

Thankyou for sending me the part of your book. I liked it and have only a few comments about what it says and some about what it doesn't say! In case you don't have the pagination in the form in which you sent it, I will key my comments to paragraph numbers and line numbers in each paragraph.

Para 1, line 8. "kept his thoughts to himself" I sent these early papers to interested people but did not start any research effort in my Division, because the Post Office could have objected.

Para 1, line 10. Yes, correct.

Para 2, line -2. Do you mean "of step-by-step telephone switching systems"?

Para 3, line -5. The fellowship was for a year but for various reasons I spent only 4 months or so at MIT, then visited other computer projects.

Para 4, line 5. The routing schemes were different from Baran's "hot potato" method, which subsequently was found to have problems. They were nearer to what ARPA adopted later.

Para 4, last line. I was concerned with communication efficiency and speed, matched to the peculiar bursty nature of computer traffic. The matching to computer traffic was the main difference with Baran's work.

Para 8 (last of extract), last line. I guess the quote was related by Paul Baran and I don't remember it, but it is apt and probably true.

If my involvement in packet switching ends with choosing the name I shall be very disappointed. I'll tell you what I think you should also include.

Our team's work at NPL may not be relevant at this point in the book, but it was significant.

We did simulation work on wide area packet switching networks, covering routing, flow control and congestion avoidance. We developed communication and file transfer protocols and published papers on all these things, during the period 1967-1975.

The original concept of "node computers" and "interface computers" to adapt to terminals was important and the latter became "terminal IMPs" in the ARPA network, quite late in their project. Because we saw the adaption of the network to many kinds of terminals and traffic as a central problem we designed and built a LAN and a file server in our

laboratory, so that we had to solve this adaption problem. The full story is in Martin Campbell-Kelly's paper in the Annals, 1988.

Influence on the ARPA network may be controversial, but I will put my point of view.

At the ACM Symposium on Operating System Principles October 1-4 at Gatlinburg, Tennessee, we presented a paper which gave a comprehensive design for a packet switched network, its performance and economics, with links up to 1.5 Mbit/s. In contrast, Larry Roberts described in his paper the current ideas for the ARPA network using 2000 bit/s channels. His only reference to the communications concept was in the last sentence which refers to "message switching and concentration".

Roger Scantlebury, who presented our paper for the four authors, reported an immense interest in our work, which had clearly gone far ahead. On another occasion (date unknown), with Herb Grosch of NBS, I visited Larry Roberts at his office in the Pentagon and saw an early ARPA design with multiple low speed links between nodes. I also saw that our 1967 paper had been used so much that its pages were falling apart.

These are the reasons that I think our work influence the ARPA project at this early stage. I hope your book can say so!

Yours sincerely,

*Donald*